Malays. Appl. Biol. (2015) 44(3): 147–151

TREE COMMUNITIES AND FLORISTIC COMPOSITION OF FRESHWATER SWAMP FOREST REMNANTS IN PERAK

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ABSTRACT

Much areas of freshwater swamp forest in Malaysia have been developed into urban settlement leaving small fragments of isolated habitat. This study was conducted to determine the plant communities and floristic composition of freshwater swamp forest in Universiti Teknologi MARA (UiTM), Sri Iskandar, Perak. A total of 17 plots measuring at 20 m × 20 m (0.68) ha were established in the study area. A total of 575 trees with diameter breast height (dbh) ≥ 5 cm were enumerated, which gives tree density estimates of 845 trees ha^{-1}. Floristic composition of tree communities at the study area comprises of 165 species, 88 genera and 36 families. Olacaceae is the most specious family, whereas the most dominant species is Nephelium costatum Hiern with an Importance Value Index (IVi) of 17.75%. Total tree basal area (BA) was 22.14 m^2 ha^{-1}. The Shannon-Weiner diversity index (H') for the study is 1.15 (H'max = 6.35). Findings from this study may contribute in identifying species of special concerns results from freshwater swamps forest habitat fragmentation.

Key words: *Freshwater swamp forest, floristic composition, Nephelium costatum Hiern*

INTRODUCTION

Freshwater swamp forest is an important ecosystem. It is a unique habitat that occurs in permanently flooded soil. The forest is usually comprised of tree species that occur in confined areas and this causes the species to become more vulnerable to extinction (Sharma and Joshi, 2008). Very little information appears to be available on the floristic composition of freshwater swamp forests. Fresh water swamp is a typical habitat where water oozes from the soil surface. It offers many important benefits including flood control, groundwater recharge, pollution cleanup, recreation (Rodrigues and Leitão-Filho, 2001) and habitat of many flora and fauna. The forest is commonly isolated, small woods, often few hectares in nature.

It also occurs in permanently or regularly flooded environments where the flooding may be tidal, irregular, or seasonal. The canopy height and complexity of freshwater are usually declined as flooding increases. The plant communities are less diverse than dry land forests. The flora species show special kinds of adaptations because of flooded or water-logged conditions of the swamp. The swamps remain completely inundated during a greater part of the year. In a study conducted in India, (Smith and Stachowiak, 1988) found that the *Myristica* swamps of Travancore remain water-logged between the months of June and January. Restricted gas exchange between rhizopshere and the aerial environment is a major problem in this context.

It decreases oxygen concentration in the root zone, elevates carbon dioxide levels and increases root resistance to water uptake (Krishnamoorty, 1960). Flooding also decreases the redox potential of the soil and other physical and chemical changes (Ponnamperuma, 1984). Tree species such as *Alstonia spatulata, Sterculia macrophylla, Syzygium papillosum* and *Dillenia reticulata* are common tree species in the freshwater swamp forests (Ubom, Ogbemudia and Benson, 2012). Forest resources in the country face increasing social and economic pressures due to an increasing population growth. This phenomenon creates conflicts between land use planning, agriculture and forest management. This has influenced the sustainability of freshwater swamp forest ecosystem.

As a result, presently only very few freshwater swamp forest areas remain in the country. Most of the areas face extinction due to anthropogenic factors, particularly a conversion to the agriculture

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activities. Whatever remains are not given necessary protection which affect the population of endangered flora and fauna. The conservation measures are insufficient and there is a fear of extinction in the remaining freshwater swamp forest species. The aim of this paper is to study the tree communities and floristic composition of freshwater swamp forest remnant in the campus field of Universiti Teknologi MARA (UiTM), Sri Iskandar, District of Perak Tengah.

MATERIALS AND METHODS

Study area

The study area is located at the freshwater swamp forest remnant located at the District of Perak Tengah, Bandar Sri Iskandar. The area is located at the north region of Peninsular Malaysia (coordinates 04°21'22.8" N and 100°57'10.1" E) (Figure 1).

A total of 17 field plots measuring of 20 m x 20 m (0.68 ha) were established in the study area. All trees with a diameter at breast height (DBH) of ≥ 5 cm (1.3 m height from the ground level) were sampled. The DBH of the sampled trees were measured and recorded. The trees were identified at species level. Leaves specimens were collected for the preparation of voucher specimens for species identification.

Data analysis

All enumerated trees were tabulated and summarized to describe the species composition and abundance of the study area. The analysis of abundance includes the determination of density, frequency and basal area (BA). The Importance Value Index (IV_i) was calculated by summing up the values of relative density (RD), relative dominance (based on basal area) (Rd), and relative frequency (RF) of each species or family [IV_i = (RD + RB + RF)/3] [7]. The measurement of species richness was determined by Margalef's index. The importance value of species is also necessary to determine the importance of particular species in the community. Species diversity was then determined using Shannon-Weiner diversity index *(H')* (Brower and Zarr, 1997).

RESULTS AND DISCUSSION

A total of 575 individuals were recorded from the study area which comprises of 165 species, 88 genera and 36 families (Table 1). Euphorbiaceae is the most dominant family which is represented by 21 species and 12 genera. Turner [9] reported that Euphorbiaceae is the second largest plant family (after Rubiaceae) represented by 70 genera and 364 species that include trees, shrubs and lianas. Euphorbiaceae and Myrtacaeae together accounts

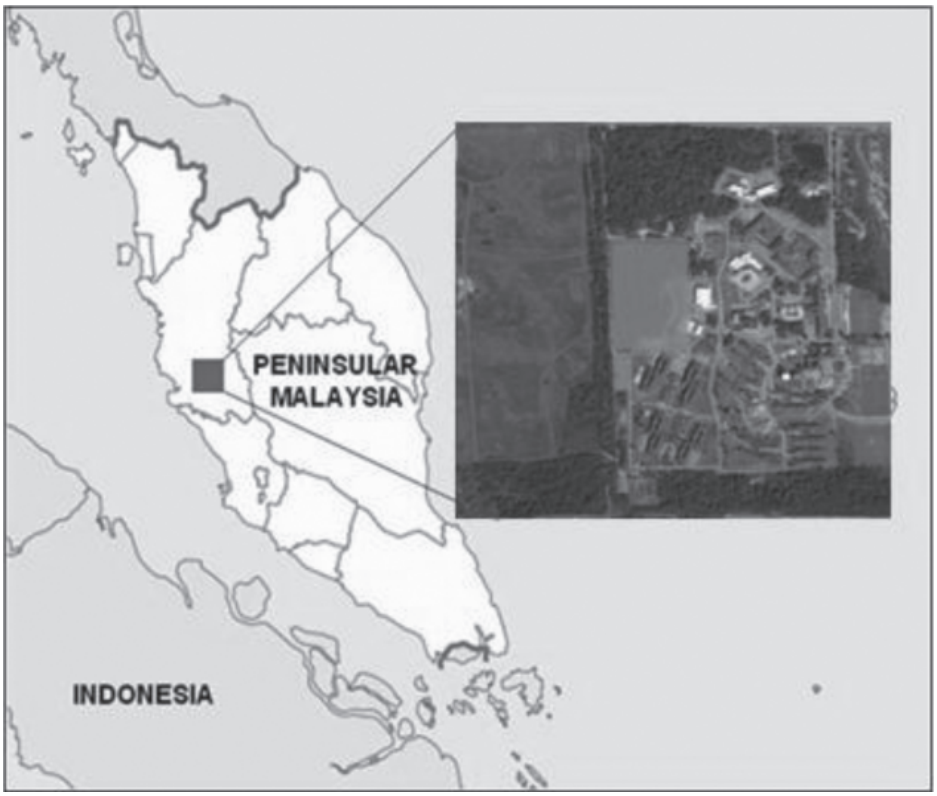

Fig. 1. The location of a study area in UiTM Sri Iskandar, Perak.

Table 1. Data of tree species from the study area (arranged in alphabetical order)

No.	Family	No. of individuals	No. of species	No. of genus
1	Anacardiaceae	56	3	3
2	Annonaceae	68	7	5
3	Aquifoliaceae	38	1	1
4	Bombacaceae	42	2	2
5	Burseraceae	21	7	2
6	Celastraceae	20	2	2
7	Chloranthaceae	20	1	1
8	Chrysobalanaceae	33	1	1
9	Dilleniaceae	13	3	1
10	Dipterocarpaceae	10	10	5
11	Ebenaceae	52	10	1
12	Elaeocarpaceae	49	2	1
13	Euphorbiaceae	6	21	12
14	Fagaceae	18	2	1
15	Flacourtiaceae	26	1	1
16	Guttiferae	8	11	4
17	Lauraceae	4	10	5
18	Lecythidaceae	19	1	1
19	Leguminosae	19	4	4
20	Melastomataceae	9	1	1
21	Meliaceae	7	5	3
22	Moraceae	6	5	3
23	Myristicaceae	4	8	3
24	Myrtaceae	3	20	2
25	Olacaceae	2	1	1
26	Oxalidaceae	7	2	1
27	Polygalaceae	5	1	1
28	Rubiaceae	2	7	7
29	Rutaceae	2	1	1
30	Sapindaceae	1	5	4
32	Sapotaceae	1	3	3
33	Sterculiaceae	1	2	1
34	Thymelaeaceae	1	2	2
35	Tiliaceae	1	1	1
36	Ulmaceae	1	2	1
	Total	575	165	88

25% of the total species found in the study area. In descending order, next families with higher number of species are Guttiferae (11 species), Dipterocarpaceae and Ebenaceae (10 species of each), Myristicaceae (eight species), Annonaceae, Burseraceae and Rubiaceae (seven species of each), Meliaceae, Moraceae, Sapindaceae (five species of each), Leguminosae (four species), Anacardiaceae, Dilleniaceae, Sapotaceae (three species of each), Bombacaceae, Celastraceae, Elaeocarpaceae, Fagaceae, Oxalidaceae, Sterculiaceae, Thymelaeaceae, Ulmaceae (2 species of each) and other ten families with only one species.

Several studies have also reported a similar observation in which the Euphorbiaceae (Koponen, 2004) was the dominant family of a freshwater swamp forest besides Fabaceae (Ribeiro Magalhães, 2012; Turner, 1995) and Myrtaceae, Melastomaceae and Rutaceae (Ivanauskas, Rodrigues and Nave, 1997). As for the species diversity, the calculated *H'* value for the study area is 1.95 (H'max = 6.35). *H2* value mainly depends on the species richness (species number) of the sampled trees. The calculated Margalef index (D) value is 25, which indicates that the study area is relatively high species diversity.

From the data analysis, it was found that the study area recorded a density of 845 trees ha^{-1}. Despite having low tree density, it presents a high family richness, especially on the woody components, as commonly found in swamp forests

Table 2. Summary of tree density, BA, IV_i of five leading families and species at freshwater swamp forest of UiTM Sri Iskandar, Perak

Variable	Tree	Value
Density (trees ha^{-1})	Family	
	Olacaceae	100
	Fagaceae	82
	Sapindaceae	76
	Myristicaceae	72
	Ebenaceae	62
	Species	
	Nephelium costatum Hiern	59
	Lithocarpus sundaicus (Blume) Rehder	26
	Shorea hemsleyana (King) King ex Foxw.	26
	Sarcotheca laxa (Ridl.) Knuth var. Laxa	25
	Artocarpus elasticus Reinw. Ex blume	24
Basal area (m^2 ha^{-1})	Family	
	Dipterocarpaceae	5.18
	Moraceae	4.73
	Euphorbiaceae	4.54
	Myrtaceae	4.62
	Sapindaceae	4.12
	Species	
	Shorea platycarpa F. Heim	2.66
	Shorea hemsleyana (King) King ex Foxw.	1.67
	Nephelium costatum Hiern	1.44
	Coelostegia griffithii Benth.	1.23
	Dipterocarpus semivestitus Sloot	1.23
IV_i	*Nephelium costatum* Hiern	5.92
	Shorea platycarpa F. Heim	5.09
	Shorea hemsleyana (King) King ex Foxw.	4.43
	Artocarpus elasticus Reinw. ex Blume	2.65
	Dipterocarpus semivestitus Sloot	2.58

(Nizam, Jeffri and Latiff, A. 2013). However, each family is represented by a few species or even by just one species, as observed in the nine families (25% of the total number of families). Higher numbers of species were found in Euphorbiaceae and Myrtaceae.

At a family level, Olacaceae represented the highest tree density with 100 trees ha^{-1}, followed by Fagaceae and Sapindaceae with 82 trees ha^{-1} and 76 trees ha^{-1}, respectively (Table 2). In terms of species, *Nephelium costatum* Hiern recorded the highest density at the species level with 59 trees ha^{-1} which represents 6.9% of total trees in the study area followed by *Lithocarpus sundaicus* (Blume) rehder and *Shorea hemsleyana* (king) King ex Foxw with 26 trees ha^{-1}.

Furthermore, the study area recorded an BA of 22.14 m^2/ha, which dominated by Dipterocarpaceae with a total value of 5.18 m^2 ha^{-1}, whilst the second and third largest are Moraceae (4.73 m^2/ha) and Euphorbiaceae (4.54 m^2 ha^{-1}), respectively. It is apparent that the previous and current studies share a common feature wherein the dipterocarps contribute to the high BA values, because the DBH size of dipterocarps commonly exceeds 55 cm [13]. Within dipterocaprs, *Shorea platycarpa* F. Heim dominated the BA (2.66 m^2 ha^{-1}), followed by *Shorea hemsleyana* (King) King ex Foxw. and *Nephelium costatum* Hiern with 1.67 m^2 ha^{-1} and 1.44 m^2 ha^{-1}, respectively.

Nephelium costatum Hiern was found to be the most important species in the study plot with an IV_i of 5.92%, followed by *Shorea platycarpa* F. Heim (5.09%) (Table 2). Apparently, there is no species that could be considered as an absolute dominance in the study area because only species that has IV_i more than 10% is considered as an absolute dominance in the community (Curtis, and MacIntosh, 1951).

CONCLUSIONS

This study demonstrates that the freshwater swamp forest of UiTM Perak is high in species diversity based on Margalef index value. The forest was dominated by *Nephelium costatum* Hiern (Sapindaceae) based on the highest density in addition to the most important species in the study plot. However, at the family level Olacaceae is the highest family in terms of the density, while in term of BA, the area is dominated by Dipterocarpaceae.

ACKNOWLEDGEMENTS

A special thanks to the Ministry of Education, Malaysia granting an FRGS grant (600-RMI/FRGS5/3 (41/2014) and to UiTM Shah Alam, UiTM Perak and FRIM for supporting this study and not forgetting colleagues who assisted in field survey. This research was also funded by UiTM's Research Intensive Faculty (RIF) Grant (600-RMI/DANA 5/3/RIF (404/2012)).

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